



PATENT  
81839.0142

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Eiichi IINO, et al.

Serial No: 10/695,609

Filed: October 28, 2003

For: SILICON SEED CRYSTAL AND  
METHOD FOR PRODUCING  
SILICON SINGLE CRYSTAL

Art Unit: 1722

Examiner: Matthew J. Song

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**APPEAL BRIEF**

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Dear Sir:

This is an Appeal from the Examiner's Final Rejection of claims 10-13. The Final Rejection issued on April 19, 2006 and the Notice of Appeal was sent to the Patent and Trademark Office on October 5, 2006. As a result of further prosecution and communication with the Examiner, claims 10 and 11 are now indicated as containing allowable subject matter, so that the appeal is directed to claims 12 and 13.

(i) **REAL PARTY IN INTEREST**

The real party in interest is Shin-Etsu Handotai Co., Ltd., Tokyo, Japan.

(ii) **RELATED APPEALS AND INTERFERENCES**

None

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(iii) STATUS OF CLAIMS

Claims 10-13 are pending, with claims 1-9 having been cancelled. This Appeal is directed to the final rejection of claims 12 and 13. The final rejection of April 19, 2006 rejects claims 10-13. However, on July 12, 2006, Applicants filed a Response to Final Office Action which argued the patentability of claims 10-13, and in an Advisory Action of August 2, 2006 mailed in response thereto, there was an indication that Applicants' Response to Final Office Action of July 12, 2006 overcame the rejection of claims 10 and 11, but not the rejection of claims 12 and 13. This is confirmed in a further Advisory Action of September 12, 2006 in response to a Response to Advisory Action which Applicants filed on August 25, 2006.

(iv) STATUS OF AMENDMENTS

This Appeal is being filed in response to the final rejection of April 19, 2006 and to the subsequent papers in the file. The subsequent papers include Applicants' Response to Final Office Action filed July 12, 2006, Examiner's Advisory Action mailed August 2, 2006, Applicants' Response to Advisory Action filed August 25, 2006 and the Examiner's Further Advisory Action mailed September 12, 2006.

(v) SUMMARY OF CLAIMED SUBJECT MATTER

Claim 10

Claim 10 defines a method for producing a silicon single crystal by the Czochralski method (page 9, line 1) which is described in conjunction with Figs. 3 and 4. The method includes the step of using a silicon seed crystal wherein oxygen concentration in the seed crystal is 12 ppma (JEIDA) or less, as described at lines 4 and 5 of page 19, Experiment Nos. 4a and 4b of Table 1 on page 20, and at lines 16 and 17 of page 29. The method includes the step of bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, as described at lines 11-13 of page 12 and at line 22 of page 12. Further in accordance with the method of claim 10, a necking operation is performed and a silicon single

crystal is grown, as described at line 13 of page 12, at line 24 of page 12 and at line 19 of page 12.

#### Claim 11

Claim 11 defines a method for producing a silicon single crystal by the Czochralski method (page 9, line 1) which is described in conjunction with Figs. 3 and 4. The method includes the step of using a silicon seed crystal which does not have a straight body portion, as described at lines 3 and 4 of page 9. The silicon seed crystal has a body shape selected from the group consisting of a cone shape, a pyramid shape, a cone shape whose side face is formed with a curved surface, a combined truncated cone and pyramid shape, and a combined truncated pyramid and cone shape, as shown in Figs. 3 and 4 and as described at lines 3 and 4 of page 9 and lines 20-26 of page 9. The method of claim 11 further includes bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, as described at lines 11-13 of page 12 and at line 22 of page 12. This is followed by performing a necking operation and growing a silicon single crystal, as described at line 13 of page 12, at line 19 of page 12 and at line 24 of page 12.

#### Claim 12

Claim 12 defines a method for producing a silicon single crystal by the Czochralski method (page 9, line 1) and as described in conjunction with Figs. 3 and 4. The method includes the step of using a silicon seed crystal wherein oxygen concentration in the seed crystal is 12 ppma (JEIDA) or less, as described at lines 4 and 5 of page 19, Experiment Nos. 4a and 4b of Table 1 on page 20, and at lines 16 and 17 of page 29. The method includes the step of bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, as described at lines 24-26 of page 13. This is followed by growing a silicon single crystal without performing a necking operation, as described at lines 26 and 27 of page 13.

#### Claim 13

Claim 13 defines a method for producing a silicon single crystal by the Czochralski method (page 9, line 1) which is described in conjunction with Figs. 3 and 4. The method of claim 13 includes the step of using a silicon seed crystal which does not have a straight body portion, as described at lines 3 and 4 of page 9. The silicon seed crystal has a body shape selected from the group consisting of a cone shape, a pyramid shape, a cone shape whose side face is formed with a curved surface, a combined truncated cone and pyramid shape, and a combined truncated pyramid and cone shape, as shown in Figs. 3 and 4 and as described at lines 20-26 of page 9. The method of claim 13 further includes bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, as described at lines 24-26 of page 13, and growing a silicon single crystal without performing necking operation, as described at lines 26-27 of page 13.

(vi) THE GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

One ground of rejection to be reviewed on Appeal is the rejection of claim 12 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 5,911,822 of Abe, et al. and further in view of Wolf, et al. (Silicon Processing in the VLSI Era, Vol. 1: Process Technology, Lattice Press, Sunset Beach, CA, USA, pp. 59-61, 1986). A second ground of rejection to be reviewed on appeal is the rejection of claim 13 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 5,911,822 of Abe, et al.

(vii) ARGUMENT

In rejecting claim 12 under 35 U.S.C. § 103(a) as being unpatentable over Abe, et al. '822 and further in view of Wolf, et al., the Final Office Action states that Abe, et al. discloses all of the limitations of claim 12 except for the claimed oxygen concentration of 12 ppma or less. Wolf, et al. is said to disclose processing and material parameters typical in Si, where the typical oxygen concentration is 10-20 ppma (page 59). Wolf, et al. is also said to teach that oxygen has a beneficial strength effect (page 61). Overlapping ranges are said to be obvious. It is then stated in the Office Action that it would have been obvious to a person of ordinary

skill in the art at the time of the invention to modify Abe, et al. by using a seed crystal having an oxygen concentration between 10-20 ppma, as taught by Wolf, et al., to obtain a sufficiently strong seed crystal for pulling a single crystal silicon ingot.

In rejecting claim 13 under 35 U.S.C. § 102(e) as being anticipated by Abe, et al., the reference is said to relate to a method of forming a silicon single crystal using the Czochralski method, and to disclose the tip end of a seed crystal being formed into a conical shape or pyramid shape in order to have a sharply pointed shape or a truncation thereof (col. 8, ln. 60-65). This is said to read on Applicants' silicon seed crystal which does not have a straight body portion but has a body shape selected from the group consisting of a cone shape and a pyramid shape. Abe, et al. is said to also disclose growing a silicon monocrystal ingot having a desired diameter without necking (Abstract). Abe, et al. is still further said to disclose a tip end portion of the seed crystal being melted to have a desired size and the seed crystal being slowly pulled upwardly from the melt (col. 10, ln. 1-67). Abe, et al. is also said to teach a seed crystal cut from a large monocrystalline line ingot (col. 8, ln. 10-25).

This Application is a divisional of Application Serial No. 09/287,199 which issued as U.S. Patent 6,670,036 on December 30, 2003. The '036 Patent is directed to a silicon seed crystal. Claim 1 of the Patent reads as follows:

1. A silicon seed crystal which is composed of silicon single crystal and used for the Czochralski method, wherein oxygen concentration in the seed crystal is 12 ppma (JEIDA) or less.

The present Application relates closely to the '036 Patent and defines a method for producing a silicon single crystal using the seed crystal of the '036 Patent.

Applicants have previously pointed out that the rejection of claims 12 and 13 on the grounds noted above is inconsistent with the issuance of the '036 Patent. This position is still maintained, and is further discussed hereafter.

The present invention is defined in terms of a seed crystal which does not have a straight body portion. Such a limitation is specifically recited in claim 13. It is impossible for the seed crystal of Abe et al. to become a seed crystal in accordance with the present invention as long as it has a straight body portion.

In the Advisory Action of August 2, 2006, the Examiner states that Applicants' argument with respect to Abe, et al. teaching a straight body portion has been noted but not found persuasive. Claim 13 is said to merely require using a seed crystal which does not have a straight body portion but has a body shape selected from a cone shape or pyramid shape. Abe, et al. is said to clearly teach a seed crystal with a body shape comprising a conical shape or a pyramidal shape (col. 8, ln. 60-65). Because claim 13 uses the term "comprising" it is said not to be limited to seed crystals with only cone or pyramid shapes, and because Abe, et al. teaches a seed crystal which does not have a straight portion, i.e. the conical or pyramid portion, such reference meets the claim limitations.

Rejected claims 12 and 13 differ from claims 10 and 11 which are now indicated as containing allowable subject matter only in reciting "without performing necking operation". The method set forth in each of claims 10-13 uses the same seed crystal. However, only claims 12 and 13 are rejected because Abe, et al. is said to disclose the seed crystal. Claims 10 and 11 are indicated as being allowable even though the same seed crystal is used therein as in the case of claims 12 and 13. Moreover, coverage of the seed crystal has been allowed in the parent Application as pointed out in the Response to Final Office Action of July 12, 2006.

It is therefore respectfully requested that the final rejection of claims 12 and 13 be reversed, and that such claims be determined to be allowable.

The present Brief is submitted herewith in triplicate. The requisite brief fee is enclosed.

If there are any fees in connection with the filing of this Appeal Brief, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,

HOGAN & HARTSON L.L.P.

Date: October 26, 2006

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(viii) CLAIM APPENDIX

10. A method for producing a silicon single crystal by the Czochralski method, comprising the steps of using a silicon seed crystal wherein oxygen concentration in the seed crystal is 12ppma (JEIDA) or less, bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, performing necking operation, and growing a silicon single crystal.

11. A method for producing a silicon single crystal by the Czochralski method, comprising the steps of using a silicon seed crystal which does not have a straight body portion but has a body shape selected from the group consisting of a cone shape, a pyramid shape, a cone shape whose side face is formed with a curved surface, a combined truncated cone and pyramid shape, and a combined truncated pyramid and cone shape, bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, performing necking operation, and growing a silicon single crystal.

12. A method for producing a silicon single crystal by the Czochralski method, comprising the steps of using a silicon seed crystal wherein oxygen concentration in the seed crystal is 12ppma (JEIDA) or less, bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, and growing a silicon single crystal without performing necking operation.

13. A method for producing a silicon single crystal by the Czochralski method, comprising the steps of using a silicon seed crystal which does not have a straight body portion but has a body shape selected from the group consisting of a cone shape, a pyramid shape, a cone shape whose side face is formed with a curved surface, a combined truncated cone and pyramid shape, and a combined truncated pyramid and cone shape, bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, and growing a silicon single crystal without performing necking operation.



(ix) EVIDENCE APPENDIX

None.

(x) RELATED PROCEEDINGS APPENDIX

None.